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**Lead Content in Hair and Health Problems at Workers in  
SPBU (Gas Station) of Gorontalo City in 2017. Public  
Health Departement, State University of Gorontalo,  
Gorontalo, Indonesia**

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**Abstract**

Lead (Pb) is a poisonous heavy metal and able to pollute environment as well as endanger health. Particle of Pb which pollutes air drives from combustion residue of motor vehicle, waste of factory production of alkil Pb and Pb-oxide, combustion of charcoal and other addictive materials. The polluted air enters human body through process of respirations. Concentrate of Pb exposure is influenced by size of particle from lead compound as well as the inhaled air volume. Research samples are workers of SPBU in Gorontalo City to investigate Pb content accumulated in workers' body and its influence towards health problems. This research aims to investigate Pb content contained in hair of SPBU workers and accumulation of Pb metal in workers' body and its influence towards health problems. This is an analytical observational research with cross sectional study approach. The research applies *Atomic Absorbtion Spechtofotometry* (AAS) to analyze specimen. Finding of hair sample test shows that based on accumulation of Pb exposure towards 48 respondents, 40 of have exceeded the Threshold Limit value namely >2,00 ppm. Then analysis of linear regression shows that value of correlation (R) coefficient between Pb content in hair towards disease complaint is 0,422 with determinant coefficient (R<sup>2</sup>) for 0,178.

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Research conclusion is accumulation of Pb exposure in 83,33% respondents has exceeded the threshold limit value. Correlations between Pb content in hair of SPBU workers in Gorontalo City toward disease complaint is 42,2% and has influence of 17,8% toward health problem of workers. Therefore, owners of SPBU are expected to provide PPE for their workers.

**Keywords:** Pb; Hair; Worker of SPBU.

## **1. Introduction**

Lead polluted air can be derived from residual combustion of gasoline additive materials from motor vehicles. Lead in the form of particles in the air comes from other sources such as Pb plant alkyl and Pb-oxide, charcoal burning, and others. The air that has been polluted by lead will enter the body through the process of breathing. Most of the breath inhaled during breathing will enter the lungs of the lungs. The rate of absorption is strongly influenced by the particle size of the existing lead compound and the volume of air which is capable of being inhaled at the time of breathing. Lead which is one element of heavy metal gases exhaust gas vehicles that can pollute the air [1-3]. Lead is commonly used as a fuel gas mixture. Lead can enter into the human body through uptake of the digestive tract or through the respiratory tract. Removal of heavy metal elements from the body by accumulating them in the hair.  $Pb^{2+}$  ion levels enter the body that excreted lead, but it is not comparable with the absorbance that can cause negative effects both acute and chronic [4,5]. The  $Pb^{2+}$  ions in the blood are bound by erythrocytes, which are divided into two namely the soft tissues (bone marrow, nervous system, kidney, liver) and hard tissue (bone, nails, hair, nails, teeth) [6].

## **2. Materials and Methods**

### **2.1. Tools and materials**

The tools used are hair clippers, used to cut respondents' hair, plastic bags, observation sheets, acetone and water, glass beker, pumpkin, pipette, set of destruction tools, vial polythelene, computer PC, digital scales, kooling module (KMS) or Cooling water systems, Atomic Absorption Spectrophotometers, and Blowers. The materials used are the hair of SPBU (sample) workers, concentrated nitric acid ( $HNO_3$ ), Perchloric Acid, and Aquadest.

### **2.2. Sampling Technique**

Each respondent took her hair approximately 0.5 to 1 cm, then put in a plastic bag that has been labeled. Recording is also done to retrieve personal data of respondents in the form of name, age, length of work and years of service. Population in this research is all people who work at gas station which is in Gorontalo City region which amount 8 gas station and hair sample is taken by purposive sampling with sample number 48 people.

### **2.3. Hair Sampling Preparation Technique and AAS Analysis**

The collected hair specimen is ready to be analyzed by washing it first with 100 ml of acetone then followed by 3 rinsing with water. Afterwards it was washed with acetone with the intention to remove fat and other contaminants that interfere with the content of the elements present in the hair, then the specimen is dried. After drying, the specimen is destructed to obtain a homogeneous result. Homogenization results are fed into the vial, each specimen is then labeled.

**C. Results and Discussion**

**Table 1:** Category of Test Result of Lead Exposure on Fuel Station Worker Samples in Gorontalo City.

HASIL ANALISIS N FAKTOR		Kategori Hasil Pengujian Paparan Timbal		
		< 2,00 ppm (Kurang dari Nilai Ambang Batas Maksimum)	≥ 2,00 ppm (Lebih dari Nilai Ambang Batas Maksimum)	Total
Kelompok Berat Badan Responden (Kg)	31 -50	1	8	9
	51 -70	4	22	26
	71 - 90	2	10	12
	91 - 110	1	0	1
<b>Total</b>		<b>8</b>	<b>40</b>	<b>48</b>
Kelompok Tinggi Badan Responden (Cm)	120 - 154	0	4	4
	155 – 169	5	28	33
	170 ≥	3	8	11
<b>Total</b>		<b>8</b>	<b>40</b>	<b>48</b>
Kelompok Umur Responden (Tahun)	20 – 39	7	28	35
	40 - 59	1	12	13
<b>Total</b>		<b>8</b>	<b>40</b>	<b>48</b>
Bidang Pekerjaan Responden	Operator	6	32	38
	Supervisor	2	8	10
<b>Total</b>		<b>8</b>	<b>40</b>	<b>48</b>
Masa Kerja Responden (Tahun)	≥ 2	8	32	40
	< 2	0	8	8
<b>Total</b>		<b>8</b>	<b>40</b>	<b>48</b>
Lama Kerja Responden dalam Sehari (Jam)	≥ 8	6	20	26
	< 8	2	20	22
<b>Total</b>		<b>8</b>	<b>40</b>	<b>48</b>
Kebiasaan Merokok Responden	Ya	6	24	30
	Tidak	2	16	18
<b>Total</b>		<b>8</b>	<b>40</b>	<b>48</b>
Terindikasi Penyakit	Ada Keluhan	0	30	30
	Tidak Ada Keluhan	8	10	18
<b>Total</b>		<b>8</b>	<b>40</b>	<b>48</b>

Data processing result of AAS and questionnaire is done by using linear regression equation with coefficient of determination formula. To know the level of Pb that accumulated in the body of the workers and its effect on health disorders of the SPBU workers. In addition, data analysis is also performed on other data to see the effect on increasing levels of lead in the body.

According to [6], the permissible exposure to lead ions in hair is less than 2,000 ppm. Based on ASS result on respondent's hair sample, 40 respondents from 48 respondents or 83.33% had exposure level of lead ion in hair ranged from 2,0031 ppm up to 3,7261. While 8 respondents or 16.67% have exposure levels ranging from 0.9733 ppm to 1.9149 ppm.

From the results of interviews and direct observation of respondents who have been exposed beyond the safe limit, as many as 30 people indicated a health problem characterized by tremor, dizziness, headache, shortness of breath, and nausea. While 10 others did not complain of these signs.

The linear regression test shows the relation (R) between lead test result on hair with indication of health problem (disease complaint) is 0,422 and its determinant coefficient (R<sup>2</sup>) is 0,178. This means that the relationship between lead test result on hair to the existence of health problem (disease complaint) is equal to 42,2% with the influence of 17,8%. There are several factors that can support the high rate of lead accumulation in the hair of SPBU workers, namely age, length of working time in the day, length of service, and smoking habit. As many as 35 people in the age group of 20 - 39 years there were 28 people exposed to lead exceed 2.00 ppm. While in the age group 40 - 59 years with 13 respondents, 12 people are exposed to exceed 2.00 ppm. Regression test showed that the relationship (R) between the age of respondents with the amount of lead exposure is 0.165 with the determinant coefficient is 0.027. Thus the relation between age of respondent to accumulation of lead exposure on hair equal to 16,5% with influence of age equal to 2,7%. Based on the length of working time in a day, of 26 people who have 8 and more working hours a day ( $\geq 8$  hours / day) 20 of them have exposure numbers exceeding the safe threshold of 2.00 ppm. While in the group of workers who have working time of less than 8 hours in a day (8 hours / day) as many as 20 people from 22 respondents have exposure rates above 2.00 ppm. Nevertheless, the result of linear regression analysis shows that the relation (R) between respondent working time and the amount of lead exposure is 0.145 or has a relationship of 14.5%. While the determinant coefficient of 0.021 or meaningful working period has an effect of 2.1% on the accumulation of lead exposure in the hair. Based on the working period divided into 2 groups ie working period of 2 years and more ( $\geq 2$  years) and working period less than 2 years ( $< 2$  years). As many as 40 people in the working group with a working period of 2 years and over, 32 of them had lead levels in hair that exceeded 2.00 ppm. But in the group with a working period of less than 2 years, amounting to 8 people, all have lead levels above 2.00 ppm. Regression test shows that the relationship (R) between the working period of respondents with the amount of lead exposure is 0.063 with the determinant coefficient is 0.004. Thus the relationship between the working period of respondents to the accumulation of lead exposure to the hair is only 6.5% alone with the effect of working period of only 0.4% which is the smallest influence factor. Of the 48 people respondents, there are 30 people who have smoking habits. 24 of them had lead exposure exceeding the allowable threshold of 2.00 ppm. While the respondents who do not have smoking habit amounted to 18 people, of which 16 people are in high exposure to lead. The result of linear regression showed the effect (R) of cigarette to increase of lead

exposure on hair is equal to 0,032 with its determinant coefficient is 0,001. Thus, it can be concluded that the effect of cigarettes on increased exposure to lead is only 3.2% with the influence of cigarettes is only 0.1%. Based on research conducted by Ajang L. and his colleagues [7] about the determination of Pb<sup>2+</sup> ion level in hair of workshop employee in Samarinda city obtained Pb<sup>2+</sup> ion content in the range of 0.2193 ppm up to 0.3665 ppm. The results of this study showed that the tendency of one's age to affect the increase in lead levels in the hair, with determination (R) of 0.839 or in other words 83.9% increase in lead levels in hair affected by age. In addition, the duration of work affect the concentration of lead ions in the hair with determination of 0.583 or 58.3%. The high number of lead accumulation in the body is caused by the number of particles that enter into the body of SPBU workers through the respiration system. Most of the inhaled lead will be absorbed by the tissues or organs of the body through the blood vessels of the lungs. [8-11]. The absorption of lead particles by the body will be greatly influenced by the particle size of the lead compound carried by air, as well as the volume of air that workers can breathe in. In addition, the absorption process is also affected by long lead exposure, circulatory system and body absorption (body metabolism). Although the number of particles of lead in the air is small, these particles will become very dangerous, because the compounds of lead compounds that are formed can give toksisitas effect on the function of organs in the human body. Lead exposure can cause disturbances in the body, although in low numbers, but without showing clinical symptoms [12-18].

#### **4. Conclusion**

Based on the result of the research, it can be concluded that the accumulation of lead exposure in 83.33% of respondents has exceeded the safe threshold value. The relationship between Lead Level in the hair of gas station workers in Gorontalo City against disease complaints amounted to 42.2% and the effect of 17.8% on health problems of workers. It is expected to the owner of SPBU to provide PPE for SPBU workers.

#### **References**

- [1] Korai, A.L., et al., Lead Concentrations in Fresh Water, Muscle, Gill and Liver of Catla Catla (Hamilton) from Keenjhar Lake. *J. Anal. Environ. Chem*, 2008. 9(1): p. 11-19. 2008.
- [2] FAO. and WHO., Summary and Conclusions. 61st Meeting, Rome, 10-19 June 2003. Retrived 10 August 2013, from website: <http://www.fao.org/english/newsroom/news/2003/19783-en.html>. 2003. 2003
- [3] Mallongi, A., P. Pataranawat and P. Parkian, 2014. Mercury emission from artisanal buladu gold mine and its bioaccumulation in rice grain, Gorontalo Province, Indonesia, *Adv. Mater. Res.*, 931-932: 744-748
- [4] Mallongi, A., P. Parkpian, P. Pataranawat, S. Chinwetkitvanich, 2015, Mercury distribution and its potential environmental and health risks in aquatic habitat at artisanal buladu gold mine in Gorontalo Province, Indonesia. *Pak. J. Nutr.* 14: 1010-1025.
- [5] Mallongi, A., Herawaty, 2015, Assessment of mercury accumulation in dry deposition, surface soil and

- rice grain in Luwuk gold mine, Central Sulawesi *Research Journal of Applied Sciences*, 10 (1) : 22-24, 2015
- [6] Palar H . 1994. *Pencemaran dan Toksikologi Logam Berat*. Bandung: Rineka Cipta. Peraturan Pemerintah Republik Indonesia Nomor 69 Tahun 1998 tentang Prasarana dan Sarana Kereta Api. Jakarta: Presiden Republik Indonesia
- [7] Ajang, L, dkk, 2015. Penentuan Kadar Ion  $Pb^{2+}$  (Timbal) Dalam Rambut Karyawan Bengkel di Kota Samarinda. *Jurnal Kimia Mulawarman* Volume 12 No. 2 Mei 2015. No. ISSN 1693-5616. Kimia FMIPA UNMUL.
- [8] Ardyanto D. 2005. *Deteksi Pencemaran Timah Hitam (Pb) Dalam Darah*
- [9] Masyarakat Yang Terpajan Timbal (Plumbum). *Jurnal Kesehatan Lingkungan*, VOL. 2, No.1, Juli 2005 : 67 - 76.
- [10] Kelompok Masyarakat Berisiko Tinggi Pencemaran Timbal. Ditjen PPM dan PLP Departemen Kesehatan RI Jakarta.
- [11] Fergusson J, E. 1991. *The Heavy Elements Chemistry Environmental Impact and Health Effects*. Pergamon Press.
- [12] Hasan, W, dkk, 2012. Pengaruh Jenis Kelamin dan Kebiasaan Merokok terhadap Kadar Timbal Darah. *Jurnal Kesmas*. Vol. 8 No. 4, November 2012.
- [13] Naria E. 2005. Mewaspada Dampak Bahan Pencemar Timbal (pb) di lingkungan terhadap Kesehatan. *Jurnal Komunikasi Penelitian* Volume 17 ( 4) 2005.
- [14] Moskoagouw D. 2000. *Kajian Peredaran Logam Berat (Hg, Cd, Pb, Cu, dan Zn) pada Perairan Pantai di Kodya Bitung Propinsi Sulawesi Utara*. Bogor: Program Pascasarjana IPB.
- [15] Khopkhar, S, M. 1990. *Konsep Dasar Kimia Analitik*. Jakarta: UI Press.
- [16] Darmono. 1995. *Logam dalam Sistem Biologi Makhluk Hidup*. Jakarta: UI-Press.
- [17] DepKes. 2001. *Kerangka Acuan Uji Petik Kadar Timbal (Pb) pada Spesimen Darah*
- [18] Kamal Z, Supriyanto C, Samin. 2007. *Analisa Cemar Logam Berat Pb, Cu, dan Cd pada Ikan Air Tawar dengan Metode Spektrometri Nyala Serapan Atom (SSA)*. Seminar Nasional, Yogyakarta.